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54 PROCEDURE AND MOULD FOR APPLICATION OF A COATING TO A PLASTIC PIECE AND THE RESULTING PIECE.

37 The invention relates to a procedure and a mould for applying a coating to a plastic piece (1).

Based on the invention, the mould consists of:

- two parts which form a principal moulding cavity (4) between them.
- the means for inserting the plastic material into the principal cavity.
- the means for pressure injection of a coating material (24) into the principal cavity, and
- a secondary cavity (12) located on the periphery of the principal cavity, between the two parts of the mould, and connected to the principal cavity by means of a passageway (14) with an internal gauge of 1 millimetre or less.

The leak proof features of the mould surface joint with respect to the coating material is improved

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The invention relates to a procedure and a mould for applying a coating to a piece made of plastic material, as well as the piece produced.

The objective is to create a coated plastic material piece with an improved appearance. The coating is usually a coat of paint.

This technique is usually referred to as "In Mold Coating" (IMC) – in French, coating inside a mould. It has the advantage of reducing the number of operations, losses of coating material, and cost of producing the piece as compared to a spray gun operation.

A mould already exists, specifically described in US-A-4 668 460, consisting of:

- two parts which enclose a principal moulding cavity,
- a means for introducing plastic material into the principal moulding cavity,
- a method for pressure injection of a coating material into the principal moulding cavity.

However, since the coating material injection pressure is elevated, leakage of the coating material from the moulding cavity frequently occurs through the mould joint surface.

This leakage prevents the maintenance of a satisfactory distribution - more or less constant over the entire piece - of coating material pressure. The coating material is thus not present over the entire surface of the piece, and the quality - at least the appearance - of the coating is perfectible.

The present invention aims to resolve these problems. To accomplish this aim, it proposes that the mould be equipped with, among other things, a secondary cavity around the principal moulding cavity, between the two parts

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of the mould, with this secondary cavity being connected with the principal cavity by means of an intermediate passage with a gauge of 1 millimetre or less.

This secondary cavity reduces the escape of coating material from the moulding cavity and coating material pressure variations within the principal cavity.

To further improve the effect of the secondary cavity(ies) on the elimination of the problems cited, the invention proposes that:

- the secondary cavity or cavities include a raised part and a space which joins the raised part and the principal cavity by means of the said passage.
- the raised part has at least locally, a gauge greater than that of the intermediate passage, and greater than or equal to 0.5 millimetres, and
- the space consists of a gap enclosed between that of the intermediate passage and the said gauge of the raised part.

The raised part favors the filling of the secondary cavity by the plastic material, specifically by creating a holding chamber for the accumulated air.

This raised part causes, among other things, a drop in the pressure of the coating material within the secondary cavity, in the case where some of the coating material would have escaped by the passage.

In order to improve the appearance of the finished piece, the invention proposes that the principal cavity include, among other things, a drop area, of a reduced gauge, near the intermediate passage.

This reduced gauge area extends the principal cavity. It creates a drop area near the intermediate passage, that is, around the principal cavity, and allows for cutting of the

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piece perpendicular to the surface of the coated piece after removal from the mould.

This solution improves the appearance of the finished piece as compared to the solution consisting of cutting the piece in the area corresponding to the intermediate passage, since the coating material only covers part of the surface of the piece.

The invention also involves a procedure. A known procedure described notably in FR-A-2 729 886 in which :

- a) a plastic material is introduced into the principal moulding cavity of the mould
- b) a coating material is injected under pressure into the principal cavity, coming into contact with the partially solidified surface of the plastic material.

However, this solution results in the problems previously mentioned. To resolve them, the invention proposes that in step a), the plastic material be introduced into at least one secondary cavity located around the principal cavity, with this introduction being effected by way of an intermediate passage which joins the principal and secondary cavities, and whose cross section gauge is such that the coating material cannot penetrate it during step b) after the plastic material has been introduced in step a).

The presence of a thin coat of plastic in the secondary cavity, all around the principal cavity, serves the function of creating a sealed joint.

The invention also deals with a part consisting of:

- a principal part whose surface is covered with a coating material, and

- a secondary part which surrounds the principal part to which it is connected by a coat of material with a thickness of 1 millimetre or less.

The invention will be clearer in the description which follows, made with reference to the attached drawings in which:

- figure 1 is a schematic cross sectional view of a mould which conforms to the invention, at the first step of the procedure,
- figure 2 is a blown up view of detail II shown in figure 1,
- figure 3 is a blown up view of detail II shown in figure 1 at the second step of the procedure,
- figure 4 is a blown up view of detail II shown in figure 1 at the third step of the procedure.
- figure 5 illustrates a variant of figure 4.

Figures 1 to 5 illustrate a mould 2 consisting of a first part 2a, concave, usually referred to as the die, and a second part 2b, convex, usually referred to as the plug.

The die 2a and the plug 2b have the principal moulding cavity 4 between them, and a secondary moulding cavity 12 around the principal cavity 4. They come into contact with one another following a joint plane which is located about the principal cavity.

The principal cavity 4 is delimited by surface 4a of the dye and surface 4b of the plug.

Die 2a contains the means of injection 6 for plastic 22 into the principal cavity 4 and an injection head 8 for the coating material discharging into the principal cavity 4 via an injection canal 9.

The secondary cavity 12 extends along the surface of mould joint 3, over the entire perimeter of the principal cavity 4. It is connected to the

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principal cavity by way of narrow passage 14. It consists of a raised part 18 and a conduit which extends peripherally to form a space 16 which connects the raised part 18 and the principal cavity 4.

Passage 14 has a gauge of 1 millimetre or less. This gauge is greater than or equal to 0.5 millimetre to permit the passage of the plastic material. A gap of less than 0.5 millimetres could however suffice for certain plastic materials.

Space 16 ranges in size between 1 and 5 millimetres, preferably about 2 millimetres. It shown here has an essentially constant gap equal to that of passage 14. It could be slightly beveled.

Raised part 18 has a gap E which exceeds that of passage 14 (ϵ) and is best set at between 0.5 and 3 millimetres, preferably about 3 millimetres. Its size L is ideally set between 0.5 and 5 millimetres, preferably about 3 millimetres.

To produce a coated plastic piece, the plastic 22 is first introduced into the principal cavity 4, here by way of injection through access 6.

The gauge (ϵ) of the passage 14 is such that it allows passage of the plastic material 22.

Once the plastic material 22 is introduced, it completely fills the principal cavity 4 and all or part of secondary cavity 12, and defines the body of the finished piece.

The plastic material is allowed to cool and then at least the surface coat 22a of material 22 which comes into contact with surface 4a, is at least partially solidified prior to injection of a coating material 24

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in the liquid state between the plastic material 22 and the surface 4a. Otherwise, the coating material 24 might not remain on the surface of the body 22 and could mix with the plastic material.

The cooling of the plastic material 22 causes it to shrink, which as a result, creates a space 20 between the body 22 and the surface 4a.

The coating material is then injected under high pressure into space 20. Preferably, body 22 has not yet completely solidified, so that it can be slightly compressed by the injection pressure of the coating material.

It should be noted that the thickness of the coating which is thus formed on the surface of body 22 generally ranges between 0.06 and 0.25 millimetres for a body whose thickness is between 2 and 3,5 millimetres.

The coating material 24 thus spreads over the entire surface 4a. In view of the smallness of gauge ϵ of passage 14, the shrinkage of plastic material 22 does not create sufficient space to allow the passage of the coating material 24, which therefore cannot penetrate into secondary cavity 12. In addition, since passage 14 is of a smaller gauge than the average gauge of body 22, the plastic material has completely hardened and is therefore incompressible in this area when coating material 24 arrives in this passage.

If, however, coating material 24 penetrated into secondary cavity 12 by passage 24, considering its small gauge, space 16 would create such a pressure drop by friction in the coating material, that in any case, the rim should not be covered with the coating material.

In addition, the raised part 18 has a relatively significant gauge E, that is to say, in the order of the average thickness of the body 22

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a space 26 is freed up in this part by the shrinkage of the plastic material. Thus, if a small quantity of coating material 24 came up to this raised part, it would be trapped there, because it would be decompressed.

The piece 1 obtained after removal from the mould, here an automobile bumper, shows a principal part and a secondary part. The principal piece consists of the body 22, the face 22a of which is entirely covered with a coating material 24. The secondary part consists of a peripheral rim 30 corresponding to the raised part 18 of the secondary cavity and a sheet 32 corresponding to space 16. The rim 30 is, as a consequence, connected to the main part of piece 1 by the sheet which has a thickness basically equal to space 16, i.e., between 0.5 and 1 millimetres in thickness.

The secondary part of the piece can therefore either be hidden from or separated from the principal piece, mainly by cutting away at the junction of the two parts, more or less parallel to the surface 22a of the body.

The variant shown in figure 5 differs from the solution presented in the previous figures in that the principal cavity 4 is extended by a drop area 34 added to its periphery, near the intermediary passage 14. The gauge e of this area 34 is reduced with respect to that of the principal cavity 4 by the presence of a boss 28 on the surface 4b near the level of joint 3.

Thus, the cutting of the piece perpendicular to its surface 22a, in the drop area 34 will be facilitated. Preferably, as illustrated by the dash/dotted line 36, the cutting is done at the edge of this drop area 34, so that only a small part of this drop area remains on the finished piece.

The entire surface of the finished piece will thus be covered by the coating material.

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It should be understood that in order for the solution offered by the invention to be completely satisfactory, it is necessary that the secondary cavity and/or the passage be present over the entire periphery of the principal cavity 4, in the form of a seal joint.

Needless to say, the invention is not limited to the applications which have just been described and which are provided by way of example only.

In particular, the means of injection 6 and/or the injection head 8 could be placed within the plug.

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Requirements

1. Mould (2) to apply a coating (24) to a piece (1) made of plastic material(22). The mould consists of:
 - two parts (2a, 2b) which enclose a principal moulding cavity (4),
 - a means (8) of injecting a coating material (24) under pressure, into the principal moulding cavity,
characterized among other things, by the presence of a secondary cavity (12) located on the periphery of the principal moulding cavity, between the two parts of the mould. This secondary cavity is connected to the principal cavity by an intermediary passage (14) with a gauge (ϵ) which is less than or equal to 1 millimetre.
2. A mould as per requirement 1, characterized by
 - the secondary cavity(ies) including a raised part (18) and a space (16) which connects the raised part and the principal cavity via the said passage.
 - The raised part presents, at least locally, a thickness (E) which is greater than that of the intermediate passage, and greater than or equal to 0.5 millimetres, and
 - the space (16) has a gauge between that of the intermediate passage (14) and the said thickness (E) of the raised part.
3. Moulded as per the requirements of 1 or 2, characterized by the fact that the mould presents a joint plane (3), the secondary cavity(ies) extend following the mould joint plane.

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4. A mould as per one or more of the previous requirements, characterized by the fact that the principal cavity includes, among other things, a drop area, of reduced gauge, near the intermediary passage.
5. A procedure which allows the application of a coating (1) to be applied to a plastic piece (22) within a mould (2), in which:
 - a) the plastic material (22) is introduced to the interior of the principal moulding cavity (4) of the mould.
 - b) a coating material (24) is injected under pressure into the principal cavity, to make contact with the partially solidified surface (22a) of the plastic material, characterized by the fact that in step a), plastic material is introduced into at least one secondary cavity (12) located in the periphery of the principal cavity, with this introduction being made by way of an intermediate passage (14) which interconnects the principal and secondary cavities, and of which the gauge is such that the coating material cannot penetrate it during step b) after the plastic material has been introduced during step a).
6. Procedure as per requirement 5, characterized by the fact that after step b), the piece is removed from the mould and the parts (30,32) of the piece corresponding to the secondary cavity are separated from parts (22,24) of the piece corresponding with the principal cavity.
7. Procedure as per requirement 6, characterized by :
 - elongation of the principal cavity by a the creation of a drop area of a smaller gauge (e), located beside the intermediate passage, and
 - the piece is cut in at the part corresponding to the smaller gauge drop area, perpendicular to the said surface.
8. The piece obtained by the application of the procedure according to one or more of the requirements 5 to 7.
9. Piece (1) in plastic material consisting of:

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- a main part (22,24) of which one surface (22a) is coated with a coating material (24), and
 - a secondary part (30,32) surrounding the main part to which it is connected by a sheet (32) the thickness of which (ϵ) is less than or equal to 1 millimetre.
10. A part based on requirement 9, characterized by the fact that the secondary part includes a peripheral rim (30) which is not covered by the coating material.